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XXXII. *The Olindiadæ and other Medusæ*, W. K. BROOKS.

XXXIII. *Budding in Perophora*, W. K. BROOKS and GEORGE LEFEVRE.

XXXIV. *Anatomy of Yoldia*, W. K. BROOKS and GILMAN DREW.

XXXV. *On the Pithecanthropus Erectus from the Tertiary of Java*, O. C. MARSH.

Prof. H. P. Bowditch was elected a member of the council in the place of Prof. G. L. Goodale, who asked to be relieved from the duties of the office. Charles D. Walcott, director of the United States Geological Survey, and R. S. Woodward, Professor of Mechanics in Columbia University, were elected members of the Academy. The death was announced of Gen. Thomas L. Casey, U. S. A. There are now eighty-nine members of the Academy, eighty-three members have died since its foundation in 1863.

During the meeting of the Academy the committee appointed at the request of the Secretary of the Interior to report on a forestry policy for the government held several sessions. Members of the Academy appeared before the Senate committee having charge of the bill to fix the standard of weights and measures by the adoption of the metric system. Profs. Ira Remsen, John Trowbridge and G. J. Brush were appointed delegates to attend the sesqui-centennial celebration of Princeton Univ. A reception was given to members of the academy and invited guests by Mr. and Mrs. Arnold Hague on the evening of April 22d.

The autumn meeting of the Academy for the reading of scientific papers will be held in New York, beginning November 17th.

*GEOLOGIC ATLAS OF THE UNITED STATES.*  
FOLIO 2, RINGGOLD, GEORGIA-TENNESSEE, 1894.

This folio consists of 3 pages of text, signed by C. Willard Hayes, geologist; a topographic sheet (scale 1 : 125,000), a

sheet of areal geology, one of economic geology, one of structure sections, and one giving columnar sections.

*Geography.*—The district of country covered by this folio lies mainly in Georgia, a narrow strip about a mile in width along its northern border extending into Tennessee. It embraces portions of Dade, Catoosa, Walker, Whitfield, Chattooga, Floyd and Gordon counties in Georgia, and of Madison, Hamilton and James counties in Tennessee. The region forms a part of the great Appalachian Valley. Its surface is marked by three distinct types of topography, viz.: plateaus, formed by hard rocks whose beds are nearly horizontal; sharp ridges, formed by hard rocks whose beds are steeply inclined; and level or undulating valleys, formed on soft or easily eroded rocks. The plateaus are confined to the western third of the district and include portions of Lookout and Sand Mountains. Their surface is generally level or rolling, with a slight inclination from the edges toward the center, giving the plateau the form of a shallow trough. They are bounded by steep escarpments rising from 1,000 to 1,200 feet above the surrounding valleys. The sharp ridges are confined to the eastern third of the district, while a broad undulating valley occupies its central portion. The latter is drained in part northward by tributaries of the Tennessee, and in part southward by streams flowing directly to the Gulf. The divide separating the two drainage systems is broad and low, and there is evidence that the Tennessee River formerly flowed southward across the divide.

*Geology.*—The rocks appearing at the surface within the Ringgold district are entirely of sedimentary origin and include representatives of all the Paleozoic groups. The oldest rocks exposed are shales, sandstones and thin-bedded limestones of lower and middle Cambrian age. These are

called the Apison shale, Rome sandstone and Conasauga shale. Above these formations is a great thickness of siliceous magnesian limestone, the Knox dolomite, the lower portion probably being Cambrian and the upper portion Silurian. The remaining Silurian formations are the Chickamauga limestone and the Rockwood sandstone. The Devonian is either wholly wanting or is represented by a single thin bed of carbonaceous shale, not over 35 feet in thickness. Above the Chattanooga black shale are the Fort Payne chert, Floyd shale and Bangor limestone forming the lower Carboniferous, and the Lookout and Walden sandstones forming the Coal Measures. Most of the formations thicken eastward, and at the same time the proportion of calcareous matter decreases, showing that the land from which the materials composing the rocks were derived lay to the east.

The region has been subjected to compression in a northwest-southeast direction, and the originally horizontal strata have been thrown into a series of long, narrow folds, whose axes extend at right angles to the direction of the compression, or northeast and southwest. The effects of compression were greatest in the eastern portion of the district, where the strata are now all steeply inclined and the basal beds form sharp ridges, while in the western portion considerable areas of strata remain nearly horizontal and form plateaus. Where the folding was greatest there was also much fracturing of the rocks, and the strata on the eastern side of a fracture are in many places thrust upward and across the broken edges of the corresponding strata on the west. Most of the ridges in the district have thrust faults of this character along their eastern bases.

*Mineral resources.*—These consist of coal, iron ore, mineral paint, manganese ore, limestone, building stone and brick and tile

clay. The productive coal-bearing formations, the Lookout and Walden sandstones, occupy the upper portions of Pigeon, Lookout and Sand mountains, having an area in this district of 116 square miles. The Lookout generally contains one, and in some places two or three, workable coal seams, but they are variable in position, extent and thickness. The Walden sandstone forms a considerable area on Lookout mountain, and contains at least one valuable seam of coal, which is extensively worked at the Durham mines. Two varieties of iron ore are found in workable quantities. The first is the red fossil or 'Clinton' ore, which occurs as a regularly stratified bed in the Rockwood formation, and is worked at various places along the base of Lookout mountain. The second variety is limonite, which occurs as a pocket deposit at the base of several of the ridges along the eastern border of the district. Associated with the latter, particularly along the faults, are deposits of manganese, generally as nodules scattered through the surface soil.

FOLIO 4, KINGSTON, TENNESSEE, 1894.

THIS folio consists of three and one-half pages of text, signed by C. Willard Hayes, geologist; a topographic sheet (scale 1:125,000), a sheet of areal geology, one of economic geology, one of structure sections and one giving columnar sections.

*Geography.*—The map is bounded by the parallels 35° 30' and 36° and the meridians 34° 30' and 35°. The district represented lies wholly within the State of Tennessee, and includes portions of Cumberland, Morgan, Roane, Rhea, Loudon, Meigs and McMinn counties. Its area is approximately 1,000 square miles, and it forms a part of the Appalachian province, being about equally divided between the valley and plateau divisions of the province. The northwestern half of the district is a portion

of the Cumberland Plateau. The surface of this half, except in the Crab Orchard mountains, is comparatively level and has an altitude of between 1,800 and 1,900 feet. Its streams flow in shallow channels until near the edge of the plateau, when they plunge into rocky gorges which form deep notches in the escarpment. The Crab Orchard mountains are formed by the uneroded portions of an anticline, the hard beds rising in the form of a low arch. Toward the southwest the hard beds were lifted higher and have been removed, exposing the easily erodible limestone beneath, and in this the Sequatchie Valley has been excavated. The southeastern half of the district lies within the great Appalachian Valley, here occupied by the Tennessee river, which flows at an altitude of about 700 feet, and above which rounded hills and ridges rise from 300 to 500 feet higher. The valley ridges have a uniform northeast-southwest trend parallel with the Cumberland escarpment, their location depending on outcrop of narrow belts of hard rocks.

*Geology.*—West of the Cumberland escarpment the geologic structure is very simple. The strata remain nearly horizontal, as they were originally deposited, except in the Crab Orchard mountains, where they bend upward, forming a low arch. East of the escarpment the strata have suffered intense compression, which has forced them into a great number of narrow folds whose axes extend northeast and southwest. The strata dip more steeply on one side of the arch than on the other; and, as a further effect of compression, the beds on the steeper (generally the northwestern) side have been fractured and the rocks on one side thrust upward and across the broken edges of those on the other. In this manner the folds first formed have in most cases been obliterated, and there remain narrow strips of strata separated by faults, and all dipping to the southeast.

The rocks appearing at the surface are entirely sedimentary—limestones, shales, sandstones and conglomerates—and include representatives of all the Paleozoic groups. The Cambrian formations consist of the Apison shale, Rome sandstone and Conasauga shale, a series which is calcareous at top and bottom and siliceous in the middle. The Conasauga passes upward through blue shaly limestone into the Knox dolomite, a formation about 4,000 feet in thickness, composed of siliceous or cherty magnesian limestone. Probably the lower portion is of Cambrian age, while the upper is undoubtedly Silurian. Above the dolomite is the Chickamauga limestone, whose upper portion toward the eastern side of the district changes from blue flaggy limestone to calcareous shale, and is called the Athens shale. The next formation is the Rockwood, which also changes toward the east from calcareous shale to hard, brown sandstone. These changes in the character of the rocks indicate that, while they were forming, the land from which their materials were derived lay to the southeast. The Devonian is represented in this region by a single stratum of carbonaceous shale, the Chattanooga black shale, which rests, probably with a slight unconformity, on the Rockwood. Above the Chattanooga are the Fort Payne chert and Bangor limestone of the lower Carboniferous, and the Lookout and Walden sandstones of the Coal Measures.

*Mineral resources.*—These consist of coal, iron ore, limestone, building stone and clay. The coal-bearing formations, the Walden and Lookout, form the surface of the greater part of the district northwest of the Cumberland escarpment, making a probably productive area of 370 square miles. The Lookout always contains one, and sometimes as many as four, beds, all of which are locally though not generally workable. The upper bed, immediately below the con-

glomerate, is the most constant. The greater part of the workable coal is contained in the Walden, the lower bed probably corresponding to the Sewanee seam farther west. This occurs in a belt 6 or 8 miles in width, along the eastern edge of the plateau. The only iron ore sufficiently abundant to be commercially important is the red fossil ore, which occurs as a regularly stratified bed in the Rockwood formation. The numerous folds east of the escarpment bring the Rockwood to the surface in long, narrow bands, along which the ore has been worked at many points. It varies in thickness from 3 to 7 feet, and, although at some places it passes into a sandy shale, it is generally a high-grade ore.

FOLIO 6, CHATTANOOGA, TENN., 1894.

This folio consists of 3 pages of text, signed by C. Willard Hayes, geologist; a topographic sheet (scale 1 : 125,000), a sheet of areal geology, one of economic geology, one of structure sections, and one giving columnar sections.

*Geography.*—The map is bounded by the parallels  $35^{\circ}$  and  $35^{\circ} 30'$  and the meridians  $85^{\circ}$  and  $85^{\circ} 30'$ . The district is wholly within the State of Tennessee, embracing portions of Bledsoe, Rhea, Sequatchie, Marion, Hamilton and James counties. It lies partly in the great Appalachian Valley and partly in the plateau division of the Appalachian province. Its surface is marked by two distinct types of topography, the plateau and the valley. The former prevails in the western half of the district, which is occupied by portions of the Cumberland Plateau and Walden Ridge, the two plateaus being separated by Sequatchie Valley. The Cumberland Plateau has an altitude of about 2,100 feet, with a level or rolling surface. Walden Ridge has an altitude of 2,200 feet along its western edge, and slopes gradually eastward down to 1,700 feet. Both plateaus are bounded by ab-

rupt escarpments from 900 to 1,400 feet in height, the upper portions being generally formed by a series of cliffs. The two plateaus are separated by Sequatchie Valley, which is about 4 miles in width. Its western side, the escarpment of Cumberland Plateau, is notched by numerous deep rocky gorges, cut backward into the plateau by streams flowing from its surface; while the eastern side, the Walden escarpment, forms an unbroken wall. The eastern half of the district is occupied by the Tennessee Valley, the river itself having an altitude of between 600 and 700 feet, while rounded hills and irregular ridges rise several hundred feet higher. Leaving the broad valley, which continues southward into Alabama, the Tennessee River turns abruptly westward at Chattanooga and enters a narrow gorge through Walden Ridge. This part of its channel is very young in comparison with the valley toward the north, and there is evidence that the river has occupied its present course but a short time, having formerly flowed southward directly to the Gulf.

*Geology.*—The rocks appearing at the surface within the limits of the map are entirely of sedimentary origin, and include representatives of all the Paleozoic groups. The Cambrian formations include the Apison shale, Rome sandstone and Conasauga shale, a series which is calcareous at top and bottom and siliceous in the middle. The Conasauga passes upward through blue limestone into the Knox dolomite—a great thickness of siliceous magnesian limestone, the lower portion of which is probably Cambrian. Above the dolomite are Chickamauga limestone and Rockwood shale, the latter becoming brown sandstone in White Ash Mountain. The whole of the deposition which took place in this region during the Devonian is apparently represented by a stratum of shale from 10 to 25 feet in thickness—the Chattanooga black shale, which

probably rests unconformably upon the Rockwood. Above the Chattanooga are the Fort Payne chert and Bangor limestone, forming the lower Carboniferous, and the Lookout and Walden sandstones, forming the Coal Measures. Nearly all the formations exhibit an increase in thickness and in proportion of sand and mud toward the east, showing that the land from which their materials were derived lay to the east and southeast.

The geologic structure is simple in the region occupied by the plateaus, and complicated in the valleys. In the Cumberland Plateau the strata are almost perfectly horizontal, while in Walden Ridge they have a slight dip from the edges toward the center. Sequatchie Valley is located upon the westernmost of the sharp anticlines which characterize the central division of the Appalachian province. In the eastern part of the district the strata have suffered compression, which had forced the originally horizontal strata into a series of long, narrow folds whose axes extend in a northeast-southwest direction. In addition to the folding, and as a further effect of the compression which produced it, the strata have been fractured along many lines parallel with the folds, and the rocks upon one side—generally the eastern—have been thrust upward and across the broken edges of those on the other side. A fault of this character passes along the western side of the Sequatchie Valley, and several formations which would normally occur there are entirely concealed.

*Mineral resources.*—These consist of coal, iron ore, limestone, building stone, and brick and tile clay. The productive coal-bearing formations, the Lookout and Walden sandstones, occupy the surface of the plateaus. They have an area within the district of about 400 square miles, and contain from one to three beds of workable coal. The beds in the Lookout are generally variable in posi-

tion, extent and thickness; those in the Walden are constant over large areas, and are worked on a considerable scale at various points along the eastern side of Walden Ridge. About 200 square miles of area of these upper coals occur within the district, on the Cumberland Plateau and the eastern half of Walden Ridge. The most important iron ore in the district is the red fossil or Clinton ore, which occurs as a regularly stratified bed in the Rockwood shale. The bed is from 3 to 5 feet thick in Sequatchie Valley, but considerably thinner in the vicinity of Chattanooga and eastward.

FOLIO 8, SEWANEE, TENNESSEE, 1894.

This folio consists of nearly four pages of text, signed by Charles Willard Hayes, geologist; a topographic sheet (scale 1: 125,000), a sheet of areal geology, one of economic geology, one of structure sections, and one giving columnar sections.

*Geography.*—The map is bounded by the parallels 35° and 35° 30' and the meridians 85° 30' and 86°, and the territory it represents is wholly within Tennessee, embracing portions of Grundie, Sequatchie, Marion, Franklin and Coffee counties. The district lies almost wholly within the western or plateau division of the Appalachian province. Crossing its southeastern corner is the Sequatchie Valley, located upon the westernmost of the sharp folds which characterize the central or valley division of the province. The larger part of the district is occupied by the Cumberland Plateau, which has a gradual ascent toward the north, rising from an altitude of between 1,700 and 1,800 feet on the south to 1,900 or 2,000 feet on the north. The plateau is limited by a steep escarpment from 1,100 to 1,500 feet in height on the east and about 1,000 feet in height on the west. Many streams have cut their channels backward into the plateau, forming deep, narrow coves, so that the escarpment forms an extremely irregu-

lar line. Small portions of Walden Ridge and Sand Mountain appear in the extreme southeastern corner of the district, these being plateaus similar to the Cumberland Plateau farther west. A small portion of the Sequatchie Valley occupies the southeastern part of the district, with an altitude of about 600 or 700 feet, while its northwestern portion is within the 'highland rim,' a broad terrace surrounding the lowlands of middle Tennessee and separating it on the east from the Cumberland Plateau.

*Geology.*—The rocks appearing at the surface are of sedimentary origin, and include representatives of all the geologic periods from Silurian to Carboniferous. The Silurian formations, consisting of the Knox dolomite, Chickamauga limestone and Rockwood shale, occur only as narrow belts in the Sequatchie Valley. The same is true of the Devonian, which is represented by a single thin formation, the Chattanooga black shale. The Carboniferous formations occupy by far the larger part of the district, the Fort Payne chert and Bangor limestone forming the lower portions of the plateau escarpments and the highland rim, while the Lookout and Walden sandstones, belonging to the Coal Measures, form the summits of the plateaus.

The geologic structure of the region is in general extremely simple. The plateaus and the highland rim to the westward are underlain by nearly horizontal strata, while Sequatchie Valley is upon a sharp, narrow fold, the beds dipping downward on either side beneath the adjoining plateaus. If the rocks which have been eroded from the top of this arch were restored, there would be a ridge several thousand feet in height in place of the present valley. In addition to the folding which the strata have suffered along this line, they have been fractured, and the beds on the east have been thrust upward and across the edges of corresponding beds on the west of the fracture, so that

along the western side of the valley the formations do not appear at the surface in their normal sequence.

*Mineral resources.*—These consist of coal, iron ore, limestone, building and road stone and clays. The Coal Measures occupy an area within the district of about 500 square miles. Not all of this area, however, contains coal beds of workable thickness, while some portions contain two or three workable beds. The lower beds, occurring in the Lookout sandstone, are variable in horizontal position, thickness and extent, so that they can not profitably be worked on a large scale; but they have been opened at many points, and supply an excellent fuel for local use. The Sewanee seam, which is found in the Walden sandstone, from 50 to 70 feet above its base, is the most important seam in the district. It has an average thickness of 4 to 5 feet over at least 80 square miles in the higher portions of the plateau, and is extensively mined for coking at Tracy and Whitwell. The iron ore of chief importance is the red fossil or 'Clinton' ore, which occurs as a regularly stratified bed in the Rockwood shale. At Inman, in the Sequatchie Valley, it attains a thickness of 5.5 feet and is extensively mined.

FOLIO 18, SMARTSVILLE, CALIFORNIA, 1895.

This folio consists of 4 pages of text, signed by Waldemar Lindgren and H. W. Turner, geologists, and G. F. Becker, geologist in charge; a topographic sheet (scale 1:125,000), a sheet of areal geology, one of economic geology and one of structure sections.

*Topography.*—The district of country represented lies between the meridians 121° and 121° 30' and the parallels 39° and 39° 30', and embraces about 925 square miles, comprising a part of the foothill region of the Sierra Nevada. The elevation ranges from 50 feet above sea-level in the

northwestern corner to over 4,000 feet in the northeastern corner. The topography is characterized by a number of parallel ridges, running in a north-northwest direction. The northeastern part has more the character of an irregular and undulating table-land. Through the ridges and the plateaus the watercourses have cut deep and narrow canyons. The Yuba River with its branches drains the larger part of the district. Noncut Creek on the north and Bear River on the south are the only other streams of importance.

*Geology.*—Sedimentary formations occupy comparatively few areas in the district, all of which have been tentatively referred to the Calaveras formation, no fossils having been found in them. They consist of slates and quartzitic sandstones, usually with northerly strike and steep easterly dip. Diabase and porphyrite occupy large areas in the central and southern parts, as well as intrusive masses of granodiorite and gabbrodiorite. Amphibolites, resulting from the dynamo-metamorphism of diabase, gabbro and diorite, also occur in several places. The rocks of the district are principally massive, in contrast to those of the districts adjoining on the south and east. However, two lines traverse it along which extensive metamorphism has taken place and schistose rocks have been developed. The superjacent rocks, resting unconformably on the older series, consist of Neocene river gravels, together with beds of andesitic and rhyolitic tuffs. Comparatively small areas of these remain, the larger part having been carried away by erosion. Pleistocene shore gravels and alluvium occupy the southwestern corner. The Ione formation is not well exposed in this district, being in part covered by Pleistocene deposits, in part removed by erosion.

*Economic Geology.*—Important and rich Neocene gravel deposits in this district have been worked at Camptonville, Nevada City,

North San Juan, Badger Hill, French Corral and Smartsville. Gold-quartz veins occur scattered throughout the area, but by far most of them are found in the immediate vicinity of Nevada City and Grass Valley. These districts are among the most important of the gold-mining regions in California. Many of the rocks of the district are adapted for building purposes. The only one in extensive use is the granodiorite, near Nevada City. The often deep-red soils in the foothill region are of residuary origin. Extensive areas of alluvial and sedimentary soils are found only in the southwestern corner.

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#### INTERNATIONAL CLOUD OBSERVATIONS.

IN a series of papers on the storm tracks and allied phenomena, prepared under the direction of the Chief of the Weather Bureau, much has been written about the cyclonic circulation at the surface of the ground, but the subject would be very incomplete without alluding to the efforts that are being made to determine the circulations of the upper atmosphere all over the globe. Theoretical solutions, to some extent confirmed by observations, have been given, and yet the true connection between the general and the cyclonic circulation has not been properly cleared up and tested by experience. So far as the general movements are concerned, the components are somewhat as follows in the northern hemisphere, those south of the equator being counterparts. Along the meridian from Lat.  $24^{\circ}$  to the equator the component is south, to the pole it is north; in middle latitude, where the extra tropical cyclones prevail, there is a northern component in the middle cloud strata, and two southern components, one near the ground and one in the cirrus strata. Along the parallels of latitude there are two systems of components; from  $0^{\circ}$  to  $35^{\circ}$  latitude, a westerly component at the surface, and an easterly